# GUN PROPELLANT BEHAVIOUR MASTERING

# DURING HANDLING AND MANUFACTORING

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**Summary :**

According to UN recommandations or national regulations, gun propellants may be classified in 1.3 or 1.1 hazard division. Handling and manufactoring small caliber gun propellants were identified to lead to mass explosion in different countries. Nevertheless, it was possible to guarantee a 1.3 classification for small caliber gun propellant in container when restricting the loading height.

Our recent full scale works have confirmed that even large caliber gun propellants are able to give also explosion mass or pneumatic explosion hazard depending on the confinement (selfconfinement or container confinement).

The methodology used by SNPE to guarantee a 1.3 classification for all kinds of gun propellants is presented in this paper. This methodology is first based on correlation between laboratory tests and small scale tests. It is secondly reinforced by TDD simulations.

## 1 - INTRODUCTION

According to UN recommandations, gun propellants may be classified 1.3 or 1.1. In fact, 1.1 hazard classification for hunting powders and small caliber gun propellants is well known and identified. But also when gun propellants are contained in metallic container, pneumatic explosion must be evaluated. Practically, everybody knows that projection hazard and explosion mass hazard are mastered in restricting the loading height of gun propellants in a given container.

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But the explosion mass is also a real risk for medium and large caliber gun propellants, at least a projection danger even if the gap of the gun propellant is lower than 110 US NOL cards in LSGT

In fact, gap test result is not sufficient for a 1.3 classification.

To guarantee this classification it is necessary

- to limit the maximum loading height of gun propellant in the container

- or  to modifie the confinement of the container.

## GENERAL METHODOLOGY TO GUARANTEE A 1.3 CLASSIFICATION

The restricted loading height is given by the following relation :

$$HC_{max} = C \times HCE$$

$HC_{max}$ = Maximum loading height

C = Container coefficient :
This coefficient is deduced from full scale test and depends on container nature and geometry

HCE = Explosion Critical Height
This value is obtained from a test realized in a steel tube : 200 mm diameter and 1,2 mm thickness.
It depends of gun propellant characteristics : web, geometry, potential,...
But also : $H_20$ and solvents contents, temperature, superficial burning moderator...

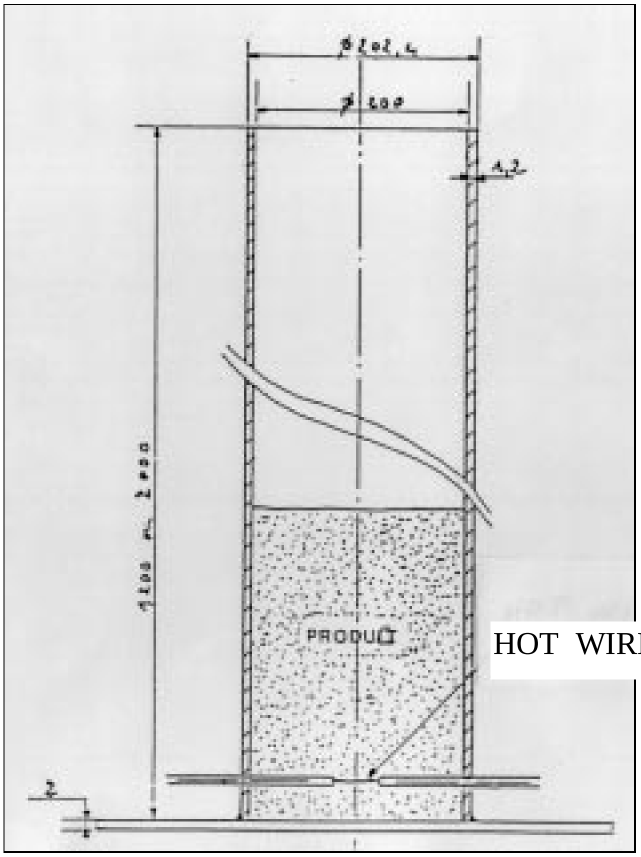

fig 1: CRITICAL HEIGHT IN STEEL TUBE ϕ 200 mm.

## 3 - HAZARD ANALYSIS FOR MEDIUM AND LARGE CALIBER GUN PROPELLANTS IN STEEL CYLINDRICAL CONTAINER

The steel cylindrical container presented fig. 2 is often used to handle medium and large caliber gun propellants during their manufacture.

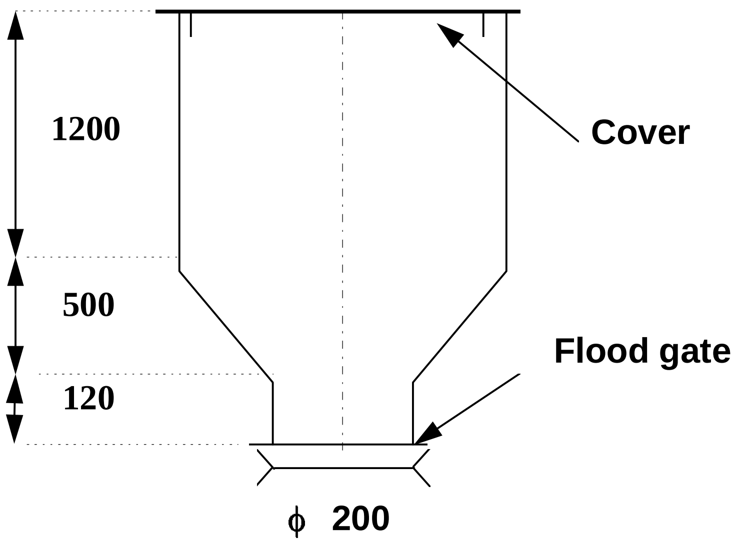


Fig.2 : Steel cylindrical container 3 mm thickness

In a first estimation, the container coefficient C given was 1.3 globaly.
But to get better precision, full scale tests were performed and more realistic coefficients were adopted.

These results are presented hereafter :

| | | | | | | |
|---|---|---|---|---|---|---|
| Cylindrical part ϕ 200 | ➔ | $C_1$ | = | 1 | | |
| Conical part | ➔ | $C_2$ | = | 3 | | |
| Cylindrical part ϕ 1400 | ➔ | $C_3$ | = | 2 | if | HCE > 0,7 |
| | | $C_3$ | = | 1,3 | if | HCE < 0,7 |

This methodology has given good results : the guarantee of 1.3 hazard classification for these operations.

## 4 - FUTURE NEEDS

But this kind of mastering using full scale tests is very expensive. Also, to master the gun propellant befaviour during handling and manufactoring, we have developped a model named CERBERE 2D.

Figure 3 below gives an example of calculation with this code.

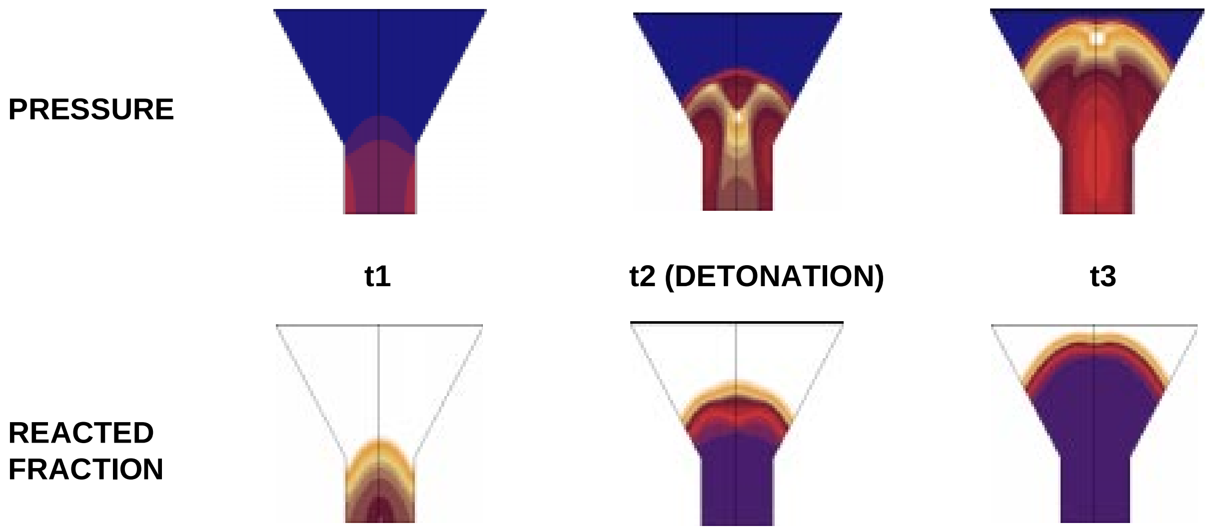


figure 3: Numerical simulation of TDD phenomena with gun powder in a conical container initiated at the bottom.

## CONCLUSION

This study permits to confirm that :

- Even large caliber gun propellants are able to give explosion mass or pneumatic explosion hazard depending upon the confinement (selfconfinement or confinement of container).

- It is possible to master the combustion by a good control of a restricted loading height using good knowledge of gun propellants and effect of container on TDD phenomenon.